

# The Biological Basis of Sex Differences in Athletic Performance:

## Consensus Statement for the American College of Sports Medicine



### At-a-Glance

#### What is an ACSM Consensus Statement?

ACSM Consensus Statements share an overview of the available evidence related to a topic of high importance, as well as expert consensus on the subject.

#### What is covered in this statement

In light of ongoing discussions about the inclusion of transgender athletes in cross-sex competition, this statement outlines the differences in athletic performance between males and females, particularly after puberty, demonstrating the basis for sex-based categories in many sports.

#### What is not covered in this statement

This is not a policy statement or recommendation about the inclusion of transgender athletes in cross-sex competition or how athletes should be categorized for recreational or competitive sports, but rather an overview of the state of the science in the field. This statement does not claim to answer all questions about this topic and acknowledges there are gaps in the data that require further research.

### Main conclusions

1. Biological sex is a primary determinant of athletic performance and physical tasks because of fundamental sex differences in anatomy and physiology dictated by sex chromosomes.
2. Before puberty, sex differences in athletic performance are minimal. Large differences emerge at puberty (~12 years) due to the anabolic effects of testosterone in males. Testosterone levels rise ~20-30 fold in males during puberty and are 15 times higher in males than females by age 18.
3. Direct and indirect effects of testosterone during male puberty include increased skeletal muscle mass due to larger muscle fiber cross-sectional area, especially fast, type II MHC fibers; lower percentage body fat; higher hemoglobin concentration and mass; larger ventricular mass and myocardial contractility; larger airways and lungs; greater body height; and longer limbs.
4. Adult males are stronger, more powerful, and faster than females of similar age and training status. The sex difference in athletic performance where endurance or muscular power is required is roughly 10-30%.
5. Past and present studies of athletic performance, acute exercise, and exercise training involve the testing of more males than females, or fail to distinguish between the sexes. Consequently, less is known about the physiology of female athletes, the limits of their athletic abilities, and the acute and adaptive response of females to exercise and training.

**More resources can be found at [acsm.org/sd](https://acsm.org/sd).**



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